

PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a processing apparatus for an image pickup element.

Related Background Art

 A conventional method for driving an area type solid image pickup element is achieved in the manner
10 illustrated in Fig. 6. An area image pickup element 101 is supplied with horizontal transfer pulses from a timing generator 909 and vertical transfer pulses via a vertical driver 105. An image picked-up signal is read out from the area image pickup element 101
15 and then supplied to an analog front end 103. The analog front end 103 sequentially performs correlated double sampling, gain adjustment and A/D conversion and supplies the processed result to a digital signal processor (DSP) 905. The digital signal processor
20 905 generates an image signal constituted of a luminance signal and color difference signals, from the supplied digital signals, and outputs the generated signal to an external via a terminal 107. The digital signal processor 905 operates in response
25 to a clock generated by the timing generator 909, and generates HD/VD pulses of NTSC or PAL to return them to the timing generator 909. The timing generator

909 establishes frame synchronization by generating various read pulses for the area image pickup element 101 in accordance with the HD/VD pulses.

A conventional timing generator is designed only
5 for each area image pickup element 101 and therefore is not compatible with other types of area image pickup elements. The timing generator is also required to be designed so as to handle not only a moving image taking mode but also a still image
10 taking mode and a monitoring mode, in case that the image pickup element has the latter two modes in addition to the moving image taking mode. If there is any change in combination of image taking modes, it is necessary to redesign a timing generator,
15 resulting in a high cost.

SUMMARY OF THE INVENTION

An object of the invention is to provide a processing apparatus capable of flexibly changing the
20 driving timings for an image pickup element.

In order to attain this object, according to an embodiment of the present invention, a processing apparatus comprises a drive pulse generator circuit for generating a drive pulse to be supplied to an
25 image pickup element and a wave form data supply circuit for supplying wave form setting data for generating the drive pulse to the drive pulse

generator circuit at each horizontal line, wherein the wave form setting data includes a wave form setting data to be set at each horizontal line and wave form setting data sharing a setting area.

5 Other objects and features of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram illustrating an example of a driving method and system to which the present invention is applied.

15 Fig. 2 is a diagram showing the details of a timing generator unit 111.

Fig. 3 is a diagram illustrating how a wave form generator circuit 225 generates a wave form.

Fig. 4 is a diagram illustrating CMD data.

20 Fig. 5 is a diagram showing the structure of circuits for generating a wave form, the circuits being built in a DSP 109.

Fig. 6 is a diagram illustrating the structure of a conventional processing apparatus.

25 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a diagram which best shows the features of this invention. In Fig. 1, reference

numeral 100 denotes an optical lens. An area image pickup element 101 is supplied, as will be later detailed, with horizontal transfer pulses H1 and H2 and a reset gate pulse RG from a timing generator unit 111 and with vertical transfer pulses V1, V2, V3 and V4 from the timing generator unit 111 via a vertical driver 105. A signal picked up by the area image pickup element 101 are supplied to an analog front end 103 to be subjected to correlated double sampling (CDS), gain adjustment (AGC) and A/D conversion, in a manner similar to conventional techniques. This digitalized image signal is supplied to a digital signal processor (DSP) 109. Similar to a conventional manner, DSP 109 generates an image signal constituted of a luminance signal and color difference signals and outputs it to an external via a terminal 107. The DSP 109 shares a roll of generating various wave forms together with the timing generator unit 111.

20 The details of the timing generator unit 111 are shown in Fig. 2. Reference numeral 201 denotes an input terminal at which a command (hereinafter abbreviated to CMD) supplied from the DSP 109 is received. Reference numeral 203 denotes an input terminal at which a horizontal timing signal (hereinafter abbreviated to HD) supplied from the DSP 109 is received. Reference numerals 205 and 226

denote a wave form generation block. Reference numeral 207 denotes a horizontal counter, reference numeral 209 denotes a decoder for decoding an output of the horizontal counter 207, reference numeral 221
5 denotes a decoder for decoding the highest level area of a CMD input, and reference numeral 222 denotes AND circuits. The wave form generation block 205 is constituted of registers 211 and 213 and a wave form generation circuit 215. Similarly, the wave form
10 generation block 226 is constituted of registers 223 and 224 and a wave form generation circuit 225. The wave form generation block 205 generates the wave form of a vertical transfer pulse VX1. Similar blocks having the same internal structure as that of
15 the block 226 are also provided for generating the wave forms of remaining four-phase vertical transfer pulses VX2, VX3 and VX4, sensor gate pulses SG1 and SG3 to be applied to the vertical transfer pulse, a PBLK pulse designating a pre-blanking portion (a
20 mask-timing portion for blocking the horizontal transfer pulse near in the area where the vertical transfer pulse is generated), an OB pulse designating an optical black portion and a DM pulse designating a dummy pixel. These signal wave forms differ greatly
25 depending upon an operation mode such as blanking and normal transferring. The wave form setting data is required as CMD at each horizontal period.

The wave form generation block 226 generates the wave form of the horizontal transfer pulse H1. Similar blocks having the same internal structure as that of the wave form generation block 226 are also
5 provided for generating the wave forms of a remaining two-phase horizontal transfer pulse H2, correlated double sampling pulses SHP and SHD, a reset gate pulse RG for supplying a reference voltage of the image pickup element 101, and an ADCLK to be used for
10 A/D conversion at the analog front end AFE 103. Since the internal structure of each of these blocks is the same as that of the wave form generation block 226, the description thereof is omitted. These signal wave forms are maintained constant
15 irrespective of the operation mode such as blanking and normal transferring.

Fig. 4 is a diagram showing CMD data which is output starting at the trailing edge of the HD signal. Wave form setting data 401 to 409 are sequentially
20 supplied in the order shown in Fig. 4. Reference numeral 401 denotes an area where flags 411 to 416 to be described later are selectively output at each horizontal synchronization. Reference numerals 402 to 410 denote data fields where signals XV1, XV2, XV3,
25 XV4, SG1, SG3, PBLK, OB and DM are set respectively. The decoder 209 decodes the data in the data fields 401 to 409. Reference numerals 411 to 416 denote the

flags "0" to "5" which are set to the upper (left) area and indicate the types of wave forms to be set. The flags "0" to "5" are used for H1, H2, SHP, SHD, RG and ADCLK, respectively. The decoder 221 decodes
5 this upper area.

Referring to Fig. 4, the horizontal counter 207 is reset at the trailing edge of the HD signal input to the terminal 203, and counts up in response to each clock DCLK. The value of the horizontal counter
10 are supplied to the decoder 209, wave form generation block 205 and AND circuits 222.

As to the area 401, the decoder 209 outputs DECO having a value "1" to the AND circuits 222 to release the masking of DECA to DECB. For example, when the
15 flag 411 is set to the area 401, the decoder 221 outputs DECA so that the CMD data (H1_set) is written in the register 223 via the AND circuit 222. In response to the next HD trailing edge, the value in the register 223 is written in the register 224 to
20 make the wave form generation circuit 225 generate the H1 waveform.

The operation of generating each wave form is illustrated in Fig. 3. Reference numeral 302 denotes a trailing edge of the horizontal blanking signal.
25 In response to this trailing edge, the wave form generation circuit 225 outputs an initial value. In the present embodiment, "1" is set to the initial

value. Reference numeral 305 denotes a change point 1 upon which the contents of CMD[A] are reflected, and the wave form is inverted at this point 1. Similarly, reference numeral 306 denotes a change point 2 upon which the contents of CMD[A] are reflected, and the wave form is inverted again at this point 2. By repeating such an operation a plurality of times, a necessary wave form can be generated. If the number of change points is set to 0 or a greater value, a wave form not changing during the horizontal period can obviously be generated. Two change points per one horizontal period are sufficient for the mask pulse of the sensor gate pulse or horizontal transfer pulse.

15 The wave form generation circuit 225 is supplied with the count value from the horizontal counter 207 and with the initial value of a waveform to be described later and several change points (in this case, the change point 1 and change point 2) from the register 224. When the count value of the horizontal counter 207 takes "0", the wave form generation circuit 225 outputs the initial value. When the values of the change point 1 and horizontal counter become equal, the wave form generation circuit 225 inverts its output value. Similarly, when the values of the change point 2 and horizontal counter become equal, the wave form generation circuit 225 inverts

its output value again. In this case, since the output is assumed to be a binary value, the same value is output when the level is inverted by even times.

5 For the vertical pulse VX1, i.e., for the area
402, the decoder 209 outputs DEC1 having a value "1"
to the wave form generation block 205. Similar to
the wave form generation block 226, the wave form
generation block 205 writes the CMD data in the
10 register 211 and writes it in the register 213 in
response to the trailing edge of HD to make the wave
form generation circuit 215 generate the waveform of
VX1. The change points are prepared as many as
necessary because the wave forms of vertical pulses
15 (VX1, VX2, VX3 and VX4) and the like are complicated.

Fig. 5 shows the structure of wave form
generating circuits built in DSP 109. Reference
numeral 501 denotes an input terminal to which the
clock DCLK is input, reference numeral 503 denotes a
20 vertical counter, reference numeral 505 denotes a
horizontal counter, reference numeral 509 denotes a
switch, reference numeral 511 denotes a command
output terminal, reference numeral 513 denotes an HD
output terminal, reference numeral 515 denotes an
25 address generation unit, reference numeral 517
denotes a microcomputer bus, reference numerals 519,
521 and 531 denote memories, reference numeral 532

denotes a switch and reference numeral 533 denotes a CPU. The vertical counter 503 and horizontal counter 505 are used for generating timings at which a two-dimensional image is read out from the area image pickup element 101. The count values of these two counters are supplied to the address generation unit 515. In accordance with the count values of the vertical and horizontal counters, the address generation unit 515 generates addresses and supplies them to the memories 519, 521 and 531. An output of the vertical counter 503 is inverted at each frame and applied to the switch 509 to alternately switch among the memories 519 and 521. The switch 509 is connected to one input terminal of the switch 532, and the other input terminal of the switch 532 is connected to an output terminal of the memory 531. In accordance with the count value of the horizontal counter 505, an output of the memory 531 is selected for the area 401 (Fig. 4) and the output of the switch 509 is selected for the other areas. In this manner, the CMD data is output to the CMD output terminal 511.

The horizontal counter 405 also generates the HD signal and outputs it to the terminal 513.

As shown in Fig. 3, at the terminals 511 and 513, CMD is output at the trailing edge of the horizontal blanking signal, and this output operation is

terminated after the necessary number of CMDs is
output. By terminating CMD near in the horizontal
blanking period, it is possible to suppress minimally
CMD data from leaking into an output of the area
5 image pickup element to become noise sources.

With this arrangement described above, data of
wave form data to be generated in the next frame is
written in advance in one of the memories 519 and 521
presently not selected by the switch 509. At the
10 next frame, the switch 509 is turned to the side of
the thus-written wave form data. Data may be written
in the memory 531 during the initial sequence such as
a power-on or in each image pickup mode.

In the manner described above, the initial value
15 for each of all wave forms to be generated during the
horizontal period and the wave form data for
predetermined number of change points for each
waveform are read out and supplied to the wave form
generation block 205 via the output terminal 511 and
20 input terminal 201.

As described so far, the wave form data to be
generated is loaded in the register 211 during the
previous horizontal period. The memories of large
scale is provided on the side of DSP 109 which is
25 driven at a low voltage in a later process of the
operation sequence, and only the horizontal counter
is provided on the side of the timing generator unit

111 for generating drive pulses of the area image pickup element. It is therefore possible to flexibly deal with change of the area image pickup element, resulting in a reduction in development cost of a DSP
5 and a timing generator unit.

Data for the next frame is written in the memories 519, 521 and 531, and during the next horizontal period, the next wave form data is written in advance in the timing generator unit 111 via DSP
10 109. With this arrangement, a versatile timing generator can be configured irrespective of the type of an area image pickup element. Even if a moving image pickup mode, a still image pickup mode and a monitor mode are all used, any one of these modes can
15 be realized easily only by sequentially changing data to be written in the memories 519, 521 and 531.

For a versatile timing generator, a large amount of setting data is required in order to flexibly deal with a change in mode or timing, and it may happen in
20 the worst case that the data may not be written within the horizontal blanking but may require the effective image area to be written, so that the image quality is degraded. According to the invention, however, wave form setting data which changes in the
25 unit of line and data which does not change in the unit of line are used separately. The latter data shares the area of wave form setting values, so that

it is possible to reduce the number of wave form
setting data to be transferred in the unit of
horizontal synchronization (line), thereby achieving
to send necessary wave form setting values within a
5 short horizontal blanking period. The invention is
particularly effective for a versatile timing
generator which requires to send a large number of
wave form setting values.

Many widely different embodiments of the present
10 invention may be constructed without departing from
the spirit and scope of the present invention. It
should be understood that the present invention is
not limited to the specific embodiments described in
the specification, except as defined in the appended
15 claims.